MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

EEL1016 – ENERGY CONVERSION I

(LE)

14 MARCH 2018
9 AM – 11 AM
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This examination paper consists of 4 pages with 4 Questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

(a) Figure Q1(a) shows the instantaneous waveforms of Component 1 and Component 2 in a power system circuit. What is the element represented by the Component 1 and Component 2, respectively?

[5 marks]

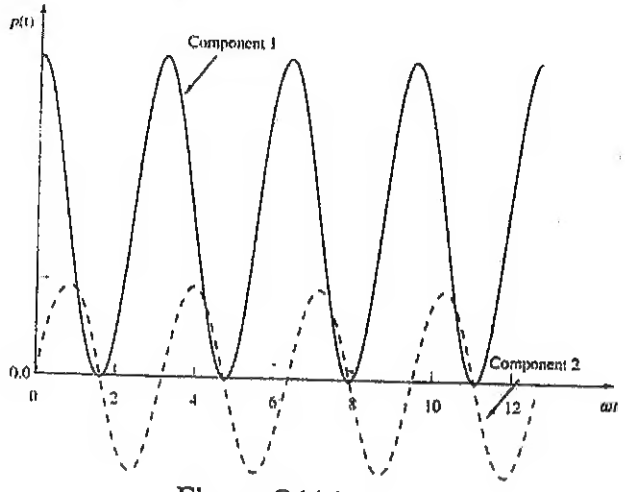

Figure Q1(a)

(b) A power system circuit shown in Figure Q1(b) has the parameters of source impedance (Z_S) 0.05 + j0.8 Ω, load impedances (Z_{L1}) 15 - j1 Ω and (Z_{L2}) 20 + j40 Ω.

(i) Calculate the $V_{SR}, V_R, I_{SR}, I_{L1}$ and I_{L2}. [8 marks]

(ii) Draw the phasor diagram for V_S, V_R, I_{SR}, I_{L1} and I_{L2}. [5 marks]

(iii) Calculate the load power factor. [1 mark]

(iv) Determine the complex and apparent powers drawn by the following impedance elements: Z_S, Z_{L1} and Z_{L2}. [6 marks]

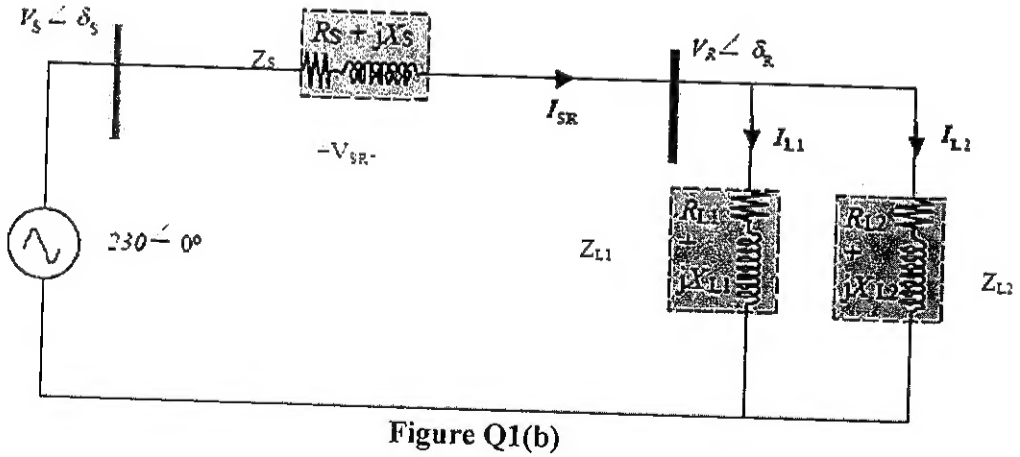

Figure Q1(b)

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Question 2

(a) Proof the following statement:

"In an ideal transformer (ignoring any losses), the power available in the secondary winding (P_{out}) will be the same as the power in the primary winding (P_{in})."

[5 marks]

(b) Figure Q2 shows an equivalent circuit of a 1000 VA, 200/100 V single-phase transformer.

(i) Calculate the equivalent resistances and reactances of the transformer referred to the secondary side. [5 marks]

(ii) Based on the calculated values in Part (i), sketch and label the equivalent circuit with primary parameters transferred to the secondary. [3 marks]

(iii) Since the excitation branch has a very small current compared to the load current of the transformer, an approximate equivalent circuit can be produced. Referring to Part (ii), sketch and label the transformer approximate equivalent circuit referred to the secondary. [5 marks]

(iv) By referring to the approximate equivalent circuit developed in Part (iii), determine the voltage regulation. It is given that the secondary voltage is 100 V, and the power supplied to the secondary load is 2000 W at 0.8 lagging power factor. [7 marks]

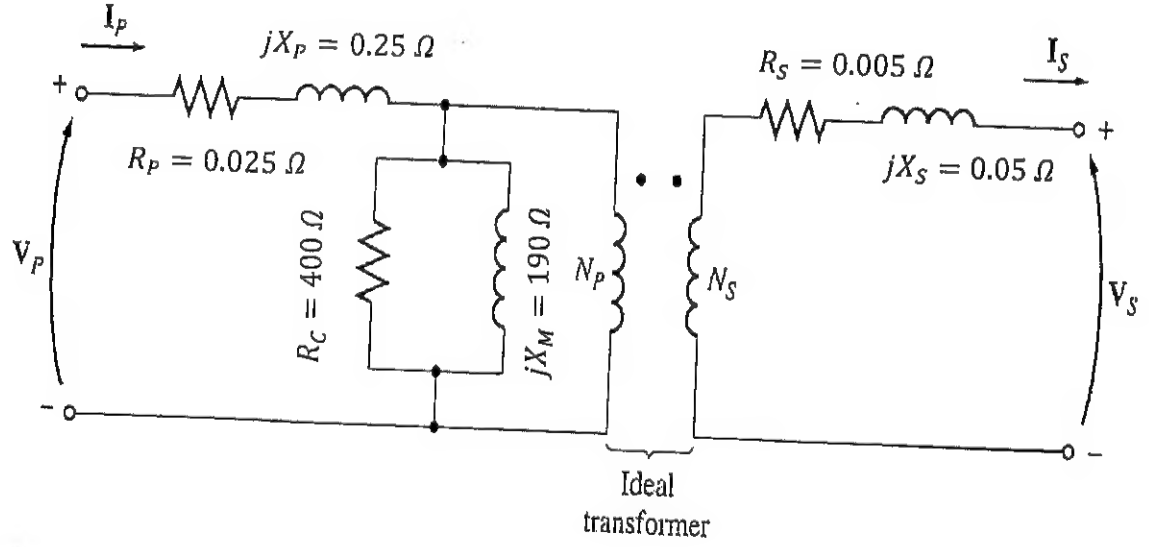

Figure Q2

Question 3

(a) Induction machine is commonly used as motor rather than generator as it has many advantages. Name any FIVE advantages of induction motor, which makes this motor to have wider applications. [5 marks]

(b) A 25 hp, Y400/Δ230 V, 50 Hz induction motor was tested in a laboratory and the following test data reported.

No load test: 400 V, 35.0 A, 1350 W
Locked rotor test: 40 V, 68 A, 2650 W
DC test: 15 V, 60 A

(i) Find the approximate equivalent circuit of this motor. Assume a design class B motor, where the stator and the rotor leakage reactances (referred to the stator) are 40 % and 60 % of the locked rotor reactances respectively at rated frequency. [15 marks]

(ii) Based on calculated values in Part (i), sketch the approximate equivalent circuit of the motor. [5 marks]

Question 4

(a) Commercial synchronous generators are built with either a Stationary Magnetic Field or Revolving Magnetic Filed.

(i) What do you understand on Revolving Magnetic Field? [2 marks]

(ii) State FIVE advantages of Revolving Magnetic Field over the Stationary Magnetic Field. [8 marks]

(b) A 3-phase, 1500 kVA, star-connected, 50-Hz, 2300V non-salient pole type alternator has a resistance between each pair of terminals as measured by direct current is 0.16 Ω. Assume that the effective resistance is 1.5 times of the ohmic resistance. The remaining test data were taken as following:

- A field current of 70 A produces a short-circuit current equal to full-load current of 376 A in each line.
- The same field current produces an *e.m.f* of 700 V on open circuit.

(i) Determine the per-phase effective resistance and synchronous reactance of the machine. [7 marks]

(ii) Find the full load regulation at 0.8 lagging power factor. [8 marks]

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